

Claims: I claim:

1. A diffusively reflective polarizer comprising:
 - a. a cholesteric film of at least two polymeric liquid crystals having a discrete microchip structure, and
 - b. at least one alignment layer attached to at least one surface of the film;
 wherein a plurality of microchips having discrete reflection wavelengths are dispersed at least two dimensionally in the cholesteric film confined by the alignment layer as a result of a phase separation process of the polymeric liquid crystals; whereby a silver white broadband reflection of circular polarization with an approximately hemispherical viewing angle is displayed on the polarizer.
2. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different mesomorphic structure.
3. The diffusively reflective polarizer as in claim 1 wherein the polymeric liquid crystals have different physic-chemical miscibility.
4. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a thermoplastic polymer.
5. The diffusively reflective polarizer as in claim 1 wherein the cholesteric film is a UV cureable thermo-set polymer.
6. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure is a composite structure of polymeric liquid crystals with different proportion.
7. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a diameter in the range of 5 ~ 30 micrometer.
8. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has at least two dimensional randomized distribution within the cholesteric film.
9. The diffusively reflective polarizer as in claim 1 wherein the discrete microchip structure has a symmetry helical axis which is normally distributed along the normal direction of the cholesteric film.

10. The diffusively reflective polarizer as in claim 1 wherein the phase separation is a thermo phase separation.
11. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers substantially the visible bandwidth.
12. The diffusively reflective polarizer as in claim 1 wherein the broadband reflection of circular polarization covers at least a portion of the invisible bandwidth.
13. A method of fabricating a diffusively reflective polarizer comprising the step of:
 - a. forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,
 - b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,
 - c. forming a film with a specula narrow band Bragg reflection,
 - d. cooling the film to the room temperature at a predetermined speed,
 - e. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchips.

wherein the microchips having a plurality of reflection wavelengths are dispersed at least two dimensionally in the cholesteric film as a result of the thermo phase separation of the polymeric liquid crystals;

whereby a broadband diffusively reflective polarizer is formed.
14. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the layer with predetermined thickness has the thickness in the range of 5 ~ 40 μm .
15. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the sufficiently low temperature is in the range of $-30 \sim 30^{\circ}\text{C}$.
16. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the controllable duration is in the range of 1 ~ 24 hours.
17. The method of fabricating a diffusively reflective polarizer as in claim 13 wherein the homogenous mixture is also including a UV initiator.
18. The method of fabricating a diffusively reflective polarizer as in claim 13 further including a UV-beam exposure step to make the polarizer high-temperature stable.

19. A method of fabricating an inter-convertible polarizer comprising the step of:
- a. forming a substantially homogenous mixture of the first polymeric liquid crystal and the second polymeric liquid crystal at a sufficiently high temperature,
 - b. applying the mixture onto at least one substrate with a predetermined surface condition to form a layer with a predetermined thickness while maintaining the mixture at mesomorphic phase,
 - c. forming a film with a specula narrow band Bragg reflection,
 - d. cooling the film to the room temperature at a predetermined speed,
 - e. maintaining a sufficiently low temperature for a controllable duration to let the first polymeric liquid crystal and the second polymeric liquid crystal partially separated into a plurality of discrete microchip structure,
 - f. heating the polarizer film in the predetermined area at a sufficiently high temperature to make the discrete microchip structure to the homogenous cholesteric structure,
 - g. repeating step d., and e.,
- whereby the diffusively broadband polarizer and the specula narrow band polarizer is interchangeable to each other.
20. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from narrow band polarizer to broadband polarizer is through the phase separation step.
21. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the conversion from broadband polarizer to narrow band polarizer is through the phase unification step.
22. The method of fabricating an inter-convertible polarizer as in claim 19 wherein the step of heating the polarizer film in a predetermined area is a thermo-scan imaging process.